

## 0.a. Goal

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

## 0.b. Target

Target 9.5: Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending

## 0.c. Indicator

Indicator 9.5.2: Researchers (in full-time equivalent) per million inhabitants

## 0.d. Series

Not applicable.

## 0.e. Metadata update

2021-12-06

## 0.f. Related indicators

9.b, 12.a, 17.6, 17.7, 17.8

## 0.g. International organisations(s) responsible for global monitoring

United Nations Educational, Scientific and Cultural Organization (UNESCO)

## 1.a. Organisation

United Nations Educational, Scientific and Cultural Organization (UNESCO)

## 2.a. Definition and concepts

Definitions:

The researchers (in full-time equivalent) per million inhabitants is a direct measure of the number of research and development workers per 1 million people.

### Concepts:

The OECD Frascati Manual (OECD, 2015) provides the relevant definitions for research and experimental development, gross domestic expenditure on R&D and researchers. Although an OECD manual, the application is global. During the 6th revision of the Frascati Manual, developing country issues were mainstreamed in the core of the Manual. The 7th edition was released in October 2015.

The following definitions, taken from the 2015 edition of the Frascati Manual are relevant for computing the indicator.

Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge.

Researchers are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods.

The Full-time equivalent (FTE) of R&D personnel is defined as the ratio of working hours actually spent on R&D during a specific reference period (usually a calendar year) divided by the total number of hours conventionally worked in the same period by an individual or by a group.

## 2.b. Unit of measure

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Per million population.

## 2.c. Classifications

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The main methodological guide, which provides international standard guidelines for measuring R&D is the OECD Frascati Manual (Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development: [http://www.oecdilibrary.org/science-and-technology/frascati-manual-2015\\_9789264239012-en](http://www.oecdilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en)).

In addition to the above, the following international classifications are used to facilitate the R&D data compilation process and the presentation of R&D statistics by various disaggregation:

International Standard Industrial Classification of All Economic Activities

(ISIC), Rev. 4, United Nations (2008): <https://unstats.un.org/unsd/cr/registry/isic-4>.

International Standard Classification of Education (ISCED) 2011, UNESCO-UIS (2012): [www.uis.unesco.org/Education/Documents/isced-2011-en.pdf](http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf).

International Standard Classification of Occupations (ISCO), International Labour Organization (2012): [www.ilo.org/public/english/bureau/stat/isco/isco08/index.htm](http://www.ilo.org/public/english/bureau/stat/isco/isco08/index.htm).

## 3.a. Data sources

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Data are collected through national R&D surveys, either by the national statistical office or a line ministry (such as the Ministry for Science and Technology).

### **3.b. Data collection method**

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The UIS sends out a questionnaire every year to collect R&D data from all countries (around 125 countries), which are not covered by the data collections of the other partner organizations such as the Organisation for Economic Co-operation and Development (OECD), Eurostat (Statistical Office of the European Union) and the Network on Science and Technology Indicators – Ibero-American and Inter-American (RICYT). In agreement with these three organisations, their data (which were collected from their member states/associated member states – around 65 countries-) are directly obtained from the respective databases (in the case of the OECD and Eurostat) or received from the partner (in the case of RICYT). There is also collaboration in Africa with the African STI Indicators Initiative (ASTII) of AU/NEPAD.

For the data UIS sends a questionnaire to, the process is the following:

1. A questionnaire is sent to focal points in countries, generally within the Ministry of Science and Technology or the national statistical office.
2. UIS processes the questionnaires, communicating with the countries in case of questions, calculates indicators and releases the data and indicators on its website.
3. Countries are requested to complete the questionnaire using the standard international classifications, therefore adjustments are generally not needed.

The other agencies have similar procedures.

### **3.c. Data collection calendar**

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UIS sends out the questionnaire in September every year. The OECD and Eurostat collect data twice per year.

### **3.d. Data release calendar**

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July every year

### **3.e. Data providers**

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Data are collected through national R&D surveys, either by the national statistical office or a line ministry (such as the Ministry for Science and Technology).

### **3.f. Data compilers**

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The UIS, Organisation for Economic Co-operation and Development (OECD), Eurostat (Statistical Office of the European Union) and the Network on Science and Technology Indicators – Ibero-American and Inter-American (RICYT), African STI Indicators Initiative (ASTII) of AU/NEPAD

### **3.g. Institutional mandate**

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The UIS is the statistical branch of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The Institute produces internationally comparable data and methodologies in the fields of education, science, culture and communication for countries at all stages of development.

## **4.a. Rationale**

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The indicator is a direct measure of the number of research and development workers per 1 million people referred to in the target.

## **4.b. Comment and limitations**

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R&D data need to be collected through surveys, which are expensive, and are not done on a regular basis in many developing countries. Furthermore, (developing) countries do not always cover all sectors of performance. In particular the business sector is not always covered.

## **4.c. Method of computation**

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Computation of the indicator Researchers (in full-time equivalent) per million inhabitants uses available population data as denominator.

## **4.d. Validation**

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For each questionnaire received from countries where UIS sends questionnaire to, UIS executes a series of quality checks and sends back a data processing report identifying problematic issues/inconsistent data to countries for their feedback, corrections as well as validation of indicators.

## **4.e. Adjustments**

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To inform of any discrepancies between standard classifications and national practices, appropriate footnotes are accompanied with data/indicators to adequately document the results and provide explanations.

## **4.f. Treatment of missing values (i) at country level and (ii) at regional level**

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- **At country level**

Missing data are not estimated by the UIS.

- **At regional and global levels**

Imputations are based on interpolations or extrapolations of data for other reference years. Second option is to make an estimate for FTE based on available headcount data. In case no data are available at all, the unweighted regional average is used as an estimate.

## 4.g. Regional aggregations

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Missing data are imputed using the methodology described above. The data for researchers in FTE are then added up by region and divided by the population data for that region. Similar for the global total.

## 4.h. Methods and guidance available to countries for the compilation of the data at the national level

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Countries are responsible themselves for the collection of R&D data at the national level, compile national totals and submit them to international organisations. All countries follow the guidelines of the Frascati Manual: [http://www.oecd-ilibrary.org/science-and-technology/frascati-manual-2015\\_9789264239012-en](http://www.oecd-ilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en).

All countries follow the international guidelines of the OECD Frascati Manual: [http://www.oecd-ilibrary.org/science-and-technology/frascati-manual-2015\\_9789264239012-en](http://www.oecd-ilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en). Countries starting to measure R&D can use UIS Technical Paper 11 for assistance, which can be downloaded here: [uis.unesco.org/sites/default/files/documents/guide-to-conducting-an-rd-survey-for-countries-starting-to-measure-research-and-experimental-development-2014-en.pdf](http://uis.unesco.org/sites/default/files/documents/guide-to-conducting-an-rd-survey-for-countries-starting-to-measure-research-and-experimental-development-2014-en.pdf).

## 4.i. Quality management

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The UIS maintains a set of data processing guidelines/standards as well as data processing tools to facilitate processing of data and ensure the quality of data.

## 4.j. Quality assurance

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The process of quality assurance includes review of survey documentations/metadata, examination of reliability of data, make sure they comply with international standards (including the OECD Frascati Manual), and examine the consistency and coherence within the data set as well as with the time series of data and the resulting indicators. During the data processing stage, for each questionnaire received from countries where UIS sends questionnaire to, the above quality aspects are looked into and a data report is produced identifying problematic issues/inconsistent data for each respective country. The UIS sends such data reports, including the calculated indicators for target 9.5, providing the countries with the opportunity to review the data/indicators and submit any clarifications or modifications/additions before releasing data at the UIS Data Centre and submitting the data to UNSD for inclusion in the global SDG Indicators Database.

## 4.k. Quality assessment

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The data should comply with the concepts/definitions and guidelines provided in the international standards (i.e. the OECD Frascati Manual) and should cover all sectors of performance, representing all institutions, which are engaged in R&D activities in the country. Criteria for quality assessment

include: data sources must include proper documentation; data values must be nationally representative, if not, should be footnoted; data are plausible and based on trends and consistency with previously published/reported values.

## 5. Data availability and disaggregation

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### **Data availability:**

Data available for over 120 countries for Researchers (in FTE) per million inhabitants

### **Time series:**

Data available in the UIS database since reference year 1996, but historical data available back to 1981

### **Disaggregation:**

Researchers can be broken down by sector of employment, field of science, sex and age.

## 6. Comparability/deviation from international standards

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### **Sources of discrepancies:**

There are no differences in the underlying data. Difference may occur due to the use of difference data for the denominator used to calculate indicators.

## 7. References and Documentation

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### **URL:**

[www.uis.unesco.org](http://www.uis.unesco.org)

### **References:**

OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris. DOI:

<http://dx.doi.org/10.1787/9789264239012-en>.

UIS Data centre:

<http://data.uis.unesco.org/index.aspx?queryid=3685>